# INSTRUCTION MANUAL

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***Sensitive Research****

INSTRUMENTS

MODEL ESH-6TCR

TYPE ELECTROSTATIC VOLTMETER

ACCURACY 1% FULL SCALE

SERIAL NUMBERS: ES-9208 THROUGH
ES-9220

* A TRADEMARK OF EIS

**ELECTRICAL INSTRUMENT SERVICE, INC.**

25 Dock Street, Mount Vernon, N.Y. 10550

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# SECTION I

## INTRODUCTION AND DESCRIPTION

### 1-1. PURPOSE AND SCOPE OF MANUAL.

1-2. This manual contains descriptive data, operation, service inspection, and maintenance instructions for a Sensitive Research Electrostatic Voltmeter (hereafter called the voltmeter), Part Number ESH-6TCR, National Stock No. 6625-01-040-6052. This equipment is manufactured by Electrical Instrument Service, Inc., Mt. Vernon, New York.

### 1-3. PURPOSE OF EQUIPMENT

1-4. The purpose of the voltmeter is to measure voltages up to 30,000 volts ac or dc.

### 1-5. DESCRIPTION.

1-6. The voltmeter is a portable, high-voltage electrostatic, single range instrument, enclosed in an aluminum case. Full scale voltage of 30,000 can be obtained. In d-c operation, the voltmeter draws no power from the circuit, but on a-c, it may draw appreciable current due to its 8 to 10 - micro-micro farad input capacitance. Voltage measurements are free from magnetic field influences and self-heating errors within the rated frequency range.

1-7. The voltmeter has three binding posts. The binding post at the end of the threaded range rod is the high side; the binding posts at the side of the case are the low side and ground terminals. A zero adjustment knob in the front permits adjustment of the pointer to exact mechanical zero. A meter movement lock knob on the front of the case protects the movement when the instrument is in transit. A carrying handle is provided to facilitate transport and a protective carrying case with handle is also provided. Measured voltages are read on the range scale on the front of the case. Specifications and dimensions are given in figure 1-2.

### 1-8. PRINCIPLES OF OPERATION.

1-9. The voltmeter has a fixed and a movable electrode. The fixed electrode is attached to a threaded range shaft. The voltage indicating pointer is attached to the rotor assembly, which is pivoted in precision upper and lower jewels. With the fixed electrode connected to the high-voltage side of the circuit to be measured, and the ground binding post connected to the ground of the circuit, the movable rotor is deflected by electrostatic action, causing the pointer to deflect over the range scale. This deflection is directly proportional to the root-mean-square value of the voltage appearing between the electrodes. A hairspring, attached to the rotor, causes the movement to return to zero after the circuit is disconnected.

1-10. D-C MEASUREMENT. When measuring a steady d-c voltage, the average torque which produces pointer deflection is the same as the instantaneous torque. On dc, the voltmeter draws a momentary charging current which drops almost instantly to a negligible value determined by the insulation resistance of the instrument. Since the charging current is negligible, the electrostatic voltmeter is considered a zero current device.

1-11. A-C MEASUREMENT. When measuring a-c voltage, the torque surges produced are mechanically averaged by the instrument movement. An accurate mechanical averaging of torque is accomplished by making the mechanical time constant of the instrument very long compared with the time of the a-c voltage being measured. On ac, the voltmeter is essentially a variable capacitor; therefore, there is very small current consumption, since the current flowing is 90 degrees out-of-phase with the voltage. Any alternating current that does flow is proportional to the frequency of the a-c voltage so that the voltmeter must be used with care when measuring r-f circuits.

| CHARACTERISTICS | TYPE OF VALUE |
|---|---|
| Type | Electrostatic |
| Full scale values | 30,000 volts ac or dc |
| Calibrated accuracy | 1.0% |
| Period | 3 to 5 seconds |
| Lowest reading | 6000 volts |
| Frequency range | DC to 25 KHz |
| Insulation resistance | 1 Million Megohms minimum |
| Capacitance | 8 to 10 uuf approximately |
| Case size | 9 in. x 12 in. x 16 in. |
| Weight | 20 lbs. |

Figure 1-2. Leading Particulars

## SECTION II

## SPECIAL SERVICE TOOLS AND TEST EQUIPMENT

### 2-1. SPECIAL TOOLS AND TEST EQUIPMENT

2-2. No special tools are required for operation and maintenance of the voltmeter. A High Voltage Calibration Test Set, Model SR-TS-13, manufactured by Electrical Instrument Service, Inc., is used for calibration. The Model SR-TS-13 has a range of 0 to 30 KV AC and DC and an accuracy of 0.05%.

## SECTION III

## OPERATION INSTRUCTIONS

3-1. PURPOSE AND USE OF CONTROLS, INDICATORS AND CONNECTORS.

3-2. The operating controls, indicators and connectors of the voltmeter are listed and illustrated in figures 3-1 and 3-2.

3-3. PRELIMINARY STARTING PROCEDURE.

3-4. Before measuring voltage, proceed as follows:

a. Place the voltmeter on a level surface. For best accuracy do not place it at an angle of more than five degrees from the horizontal in any direction.

b. Rotate the transit knob in a counter-clockwise direction in order to release the movement from the transit position. The pointer should swing freely when the transit lock is disconnected.

c. Adjust the pointer to mechanical zero by rotating the zero shifter knob. The pointer is zeroed correctly when the pointer and zero line of the scale coincide exactly without parallax.

WARNING

Remove power from the circuit being measured before making connections. Contact to voltages measured by the equipment is dangerous.

3-5. OPERATING PROCEDURE. (See figure 3-1 and 3-2.)

3-6. To operate the voltmeter, proceed as follows:

a. Turn off power to the circuit being measured.

b. Connect the low potential or ground side of the circuit under test to the low side of ground binding post.

NOTE

Keep the high voltage side clean and free from moisture. In cases of high room humidity, turn off the voltage and wipe the rear electrode insulator with moisture-absorbent cloth or paper. Dry well.

c. Connect the high potential side of the circuit under test to the high side binding post. Apply voltage and allow the pointer to come to rest. Read the voltage from the scale.

| CONTROL, INDICATOR AND CONNECTOR | FUNCTION |
|---|---|
| Case Ground | For grounding case. |
| Zero shifter | Zero adjusts mechanical pointer. |
| Voltage scale | Indicates voltage measurements. |
| High voltage terminal | Provides connection to high side of circuit being tested. |
| Transit knob | Provides for movement protection when instrument is in transit. |
| Low side of circuit and case ground terminal | Provides connection to low side of circuit being tested. |

Figure 3-1. Function of Operating Controls, Indicators and Connectors

MODEL ESH

ELECTROSTATIC VOLTMETER

SINGLE RANGE INSTRUMENT

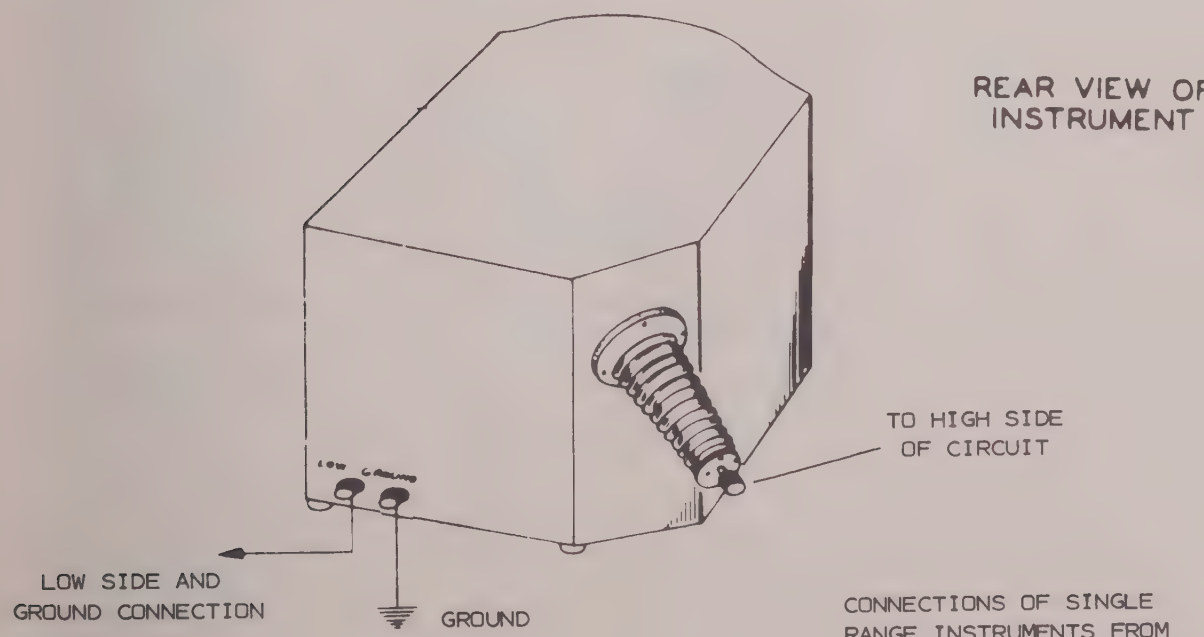

REAR VIEW OF INSTRUMENT
TO HIGH SIDE OF CIRCUIT
LOW SIDE AND GROUND CONNECTION
GROUND
CONNECTIONS OF SINGLE RANGE INSTRUMENTS FROM 5000 VOLTS TO 60000 VOLTS

FIG. 3-2

## SECTION IV

## PERIODIC INSPECTION, MAINTENANCE AND LUBRICATION

4-1. PERIODIC INSPECTION.

4-2. Inspect the voltmeter before each day's operation. Perform a careful visual inspection as listed in figure 4-1.

4-3. CLEANING AND PREVENTIVE MAINTENANCE.

4-4. Perform the following cleaning and preventive maintenance procedures monthly:

a. Use a lint-free cloth to remove dust, dirt, grease, and moisture from the case, electrode body, ground and terminal posts, meter window, and threaded range shaft.

b. Remove any corrosion from exposed metal surfaces with No. 0000 emery cloth. Touch up bare spots with paint with the exception of the binding posts and threaded range shaft.

4-5. LUBRICATION.

4-6. Lubrication of the voltmeter is not required.

| ITEM | INSPECTION |
|---|---|
| Meter | Check for broken glass, bent or broken meter pointer, or loose connections. |
| Terminal posts | Examine terminal posts for dirt, corrosion, or looseness. |

Figure 4-1. Periodic Inspection

## SECTION V

## TROUBLESHOOTING

### 5-1. GENERAL

5-2. Troubleshooting techniques are limited to a few simple tests to see whether the voltmeter is operating properly. If a malfunction is apparent in the voltmeter, a check for balance or friction may be performed. These checks will determine if there is pivot or movement damage.

5-3. BALANCE TEST. To check the voltmeter for proper balance, proceed as follows:

a. Using the zero shifter, adjust the pointer to read exact zero.

b. Tip the voltmeter up slowly from the side farthest from the operator to an angular position of 10 degrees, and tap gently. The pointer should not move more than 1 per cent of the full scale deflection.

c. Lay the instrument flat again and then tip it on the left side to an angular position of 10 degrees, and tap gently. The pointer should not move more than 1 per cent of the full scale deflection.

d. Repeat step c, tipping the meter on its right side.

5-4. FRICTION TEST. To check the voltmeter for mechanical friction, proceed as follows:

a. Connect the voltmeter to a 8000 to 10,000 volt power source which will provide at least 25 per cent of full scale reading.

b. Reduce the deflecting voltage to zero. The pointer should return to zero without tapping.

## SECTION VI

## CALIBRATION

6-1. CALIBRATION PROCEDURE.

6-2. Perform a calibration check after every six months of operation. Allow the voltmeter to remain at an ambient room temperature of 25°C (77°F) for a period of four hours before performing a calibration check.

a. With no power applied, connect the circuit being tested to the voltmeter.

b. Apply power to the circuit being measured and perform the friction test described in paragraph 5-4.

c. Connect the High Voltage Calibration Test Set to the Voltmeter. Connect the low potential or ground side of the test set to the side post and the high potential side of the test set to the high side binding post.

d. Control the applied voltage to slowly deflect the pointer up and down the scale. The pointer action must be smooth, with no sticking or hesitation at any point. Do not mistake a rough spot in the controls of the High Voltage Calibration Test Set for sticking of the voltmeter pointer.

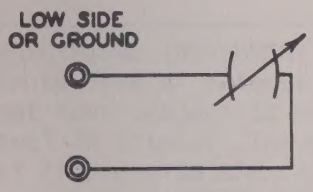
e. Check the cardinal points of the voltmeter scale against the settings of the High Voltage Calibration Test Set. Be careful to avoid parallax when reading the voltmeter scale.

# SPECIFICATIONS & SCHEMATIC DIAGRAMS
# OF
# ELECTROSTATIC VOLTMETERS

**TYPE** ESH
**MODEL** ESH-6TCR **INSTRUMENT Nº**
**CODEWORD** ----
**RANGES** 0 - 30 KV
**DIAGRAM Nº** 1

**SPECIAL FEATURES**

PER MIS-29716

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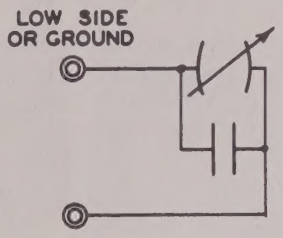


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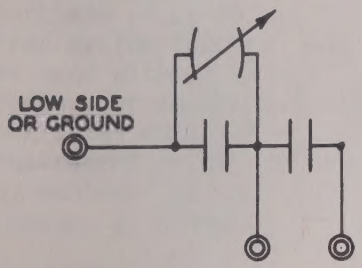


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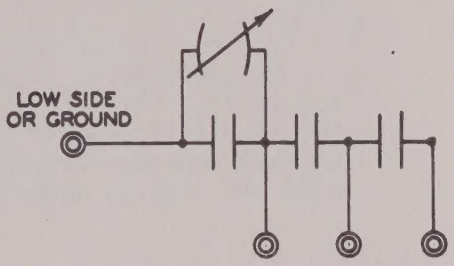


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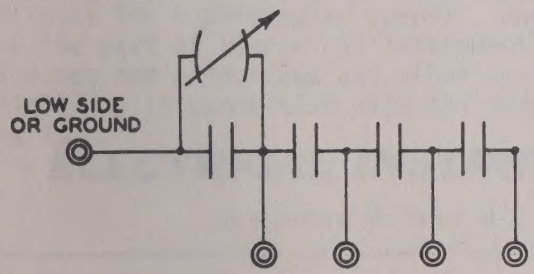


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# WARRANTY

ELECTRICAL INSTRUMENT SERVICE, INC. warrants each instrument sold by it to be free of defects in material and workmanship providing that it has not been subject to electrical or mechanical abuse and the instrument seal is intact. The effective period of the warranty is from the date of shipment to the original purchaser for a period of two (2) years except where a specific warranty is stated in the operating manual.

The Seller will not be liable for incidental or consequential damages. The Seller's sole liability shall be repair, replacement, or return of purchase price at our option. Warranty returns first must be authorized by the factory, and repairs or replacements (at our option) will be made without charge for instruments returned freight prepaid to the factory or authorized repair depot when our examination satisfactorily indicates that defects are due to workmanship or materials. If the instrument or any portion thereof has been abused, misused, damaged by accident or negligence, or if any serial number or seal has been removed or altered, this warranty is VOID.

This warranty is expressly in lieu of any other warranties expressed or implied, including any implied warranty of merchantability, or fitness for a particular purpose, any other obligations or liability on the part of Electrical Instrument Service, Inc., and it neither assumes nor authorizes any other person to assume for it any other liability in connection with the sale of instruments manufactured by it.

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